sun, nor can sea-mammals absorb to any extent that way as the heat does not penetrate enough. The surrounding medium is always below body temperature and the heat flow is always from the body not into it. As all mammals seem to depend upon more or less constant loss of superfluous heat by radiation and much loss during exertion, the black colors are probably of as great use to whales and porpoises, as to elephants and similar hairless tropical animals who likewise are never exposed to extremes and whose ranges of temperature do not differ markedly from those of the sea mammals. That is, there must be, as in horses, some means of preventing overheating, and color surely helps according as the animal is shaded or exposed to the sun. The amazing differences in horses can be logically explained on these lines, as seen in the above paper. Hence there is a suspicion that dark color in all sea-fishes at any depth has some unknown relation to the temperature, as well as the need of concealment. It must be remembered that the inner surfaces of shells, and the concealed surfaces of some parts of the bodies of many animals are most unaccountably pigmented. Neither the food nor protection from light nor resemblance to the background can be the reason, nor can it be a vestige of a previous useful condition. Indeed it is a puzzle which needs explanation, and it is requested that in all future studies there be facts presented as to the temperature of both the water and the body of the animal. It is not likely that the deep-sea fish can function at such low temperatures as we are told do exist, and it is probable that we shall find that where life is abundant the temperature of both fish and water is considerably above 40° but that in the vast areas where no life at all is found the cold may be the prohibitive factor. There must be as great variation from place to place by reason of currents as in the air. The prevalent winds make only a few degrees difference between the temperature of the northeast and southwest of Japan, but the horses in the first place are dark brown and in the latter light yellow for this reason alone. There must be similar local differences in the deep sea, due to currents to account most fully for differences in pigmentation. If the color darkens with increasing depth and coldness, then the animals surely lose by radiation what little heat they have and must be unable to function at all. Unless, then, there are different laws for the deep sea life, of which we can not conceive at present, there must be another reason for a concealing blackness which would be a fatal radiator to ancestral types nearer the surface. Indeed there may be some unknown laws of heat radiation under such tremendous pressures, which actually reverse matters and make the pigment a conserver of body heat in cold water. It can scarcely be believed that the color is to help absorption of heat, for there is little to be absorbed—the animal must depend on its own heat production. That is, the facts so far known do not explain the blackness of the deep sea fish.

CHAS. E. WOODRUFF

PHYSIOLOGICAL SEX DETERMINATION

AN interesting, if not convincing, collation of arguments in support of the notion that the suprarenal capsules are concerned in determining the sex of offspring was presented to the Paris Academy of Sciences on November 20, 1911, by Dr. R. Robinson. His arguments fall into three groups.

1. *Clinical observations.*

It has been shown by Dr. Fieux Agregi, of Bordeaux, that when the heart-beat of the fœtus is between 136 and 150 per minute there is born a female in 68 per cent. of the cases; if the heart-beat is more than 150 it is always a male. He had fifty cases. Robinson not only confirmed Agregi's observations, but was able to determine the retarding action of the administration of adrenalin upon the pulse of the fœtus. He therefore presumes that if this substance were administered from the early days of pregnancy it would influence the heart-beat and so the sex of the fœtus.

2. *Anatomo-physiological facts.*

The adrenal glands seem to influence the development of the individual after birth, if they do not cause the determination of the

sex immediately after conception; this is shown by their relations to some of the secondary sexual characters. In England a woman of 32 years who had never menstruated, had hair on face, etc., and other appearances of a man; an autopsy showed the presence of large tumor on the suprarenal. Bortz, the German surgeon, observed a girl of 16 who took on the characters of the male—beard, deep voice, distribution of hair on body, etc. Post-mortem examination showed tumor on suprarenal. A woman of 26 years was observed by a Dutch physician: she was obliged to shave like a man. Autopsy showed one of the suprarenals enclosed within the ovary. Similar facts have been published by many physicians.

3. *Chemical reactions.*

Is there any means, asks Robinson, of knowing approximately the functional state of the suprarenal capsules in the gravid female? This is worth studying if we are to come to an understanding of sex determination. Violent or obstinate vomiting and other symptoms of suprarenal insufficiency are not constant in their manifestations. He therefore used the Fränkel-Allers test (acid iodate of potassium) to reveal the slightest trace of adrenalin in the urine or blood. He used also the method of Vulpian (perchloride of iron); but found the per-iodate of potassium much more sensitive and certain in its reactions. By these means he foretold the sex of a fœtus in the fourth month.

From all these facts he thinks it is safe to conclude that the adrenalin influences the sex of the developing embryo, at least in the higher vertebrates or in man.

The hypothesis that adrenalin influences the heart-beat has been subjected to experiment and has been confirmed; but the hypothesis that the rate of the heart-beat determines the sex is one that may be tested experimentally, but has not yet been so tested. It is interesting to note that in the clinical observations given by Robinson the heart-beat of the male is higher than that of the female; this is contrary to the commonly accepted relation. The argument, moreover, may prove too much. If maleness is converted into femaleness by the adrenalin directly, or indirectly through the influence of this upon the circulatory system, it should be possible to bring on secondary female characters in a male by the administration of adrenalin before or at puberty.

The number of cases in which the sex was foretold on the basis of the Fränkel-Allers test for adrenalin in the blood or urine is not given by Robinson; presumably too few to warrant statistical conclusions. But even if the number were very large, and even if there should be found a constant relation between the sex of the fœtus and the quantity of adrenalin produced in the pregnant mother, these facts would by no means indicate a causal relation in the sense assumed by Robinson. It is quite conceivable that, in the case assumed, the physiological state of the fœtus determines the activity of the mother's adrenal capsules.

A more general criticism of Robinson's argument lies in the tacit assumption that sex differentiation means one thing in the higher vertebrates and man, and quite a different thing in the rest of the animal kingdom and in plants. It may well be that there are several distinct factors concerned in sex determination, but these must all belong to related categories. It is extremely improbable that sex is determined by an accessory chromosome among insects, by adrenalin among mammals, by traumatism among gramineæ, say, and by ultra-violet rays among mosses. It is interesting to note, in conclusion, that physicians have formulated several theories of sex determination in recent years, but always in complete innocence of the work being done by experimental biologists along this line.

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Societies and Academies

The American Mathematical Society

The one hundred and fifty-seventh regular meeting of the society was held at Columbia University on Saturday, February 24, extending through the